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5 such as whether a terminal is receiving a transmission at all. Detailed information regarding how a transmission is received, or how a transmission is displayed, is typically not fed back to the transmission source. And typically, if this information is fed back to the transmission source, the transmitter may adjust the transmission or may not, but does so without regard to the receiver's individual preferences.

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SUMMARY OF THE INVENTION

The prior art lacks a meaningful way of passing suggestions from the receiver to the sender to take certain actions to improve the quality of what is displayed based on the receiver's preferences.

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As a context for the present invention, but not the only context, consider a server transmitting multimedia data to a client. It would be beneficial for the client to have some way of feeding information back to the server to maximize the quality of the multimedia transmission. For example, although not the only example, if a client desires to receive multimedia data from one or more servers, and the client is also running applications that consume memory and negatively impact on the way the multimedia data is displayed, the client would benefit from being able to suggest to the server various ways to alter the transmission such that the client's display is improved. Some examples of suggestions to the server, although not the only examples, include suggestions to cut out certain transmitted frames and reduce the transmitted audio channels.

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With this contextual example in mind, in one embodiment of the present invention, data is received and its quality of service is analyzed. Then, based on this analysis and on received user preferences, the receiver formulates a suggestion for the encoder to alter the characteristics of the transmitted data. Finally, the receiver transmits this suggestion to the transmitter.

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BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a system overview of an embodiment of the present invention.

FIGURE 2 is a flow chart illustrating an embodiment of a method according to the present invention.

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5 FIGURE 3 is a flow chart illustrating another embodiment of a method according to the present invention.

FIGURE 4 is a pictorial representation of an apparatus according to one embodiment of the present invention.

FIGURE 5 is a pictorial representation of another apparatus according to one
10 embodiment of the present invention.

DETAILED DESCRIPTION

The present invention relates to methods and systems for improving the quality of displayed data that has been transmitted over a network. For the purposes of the
15 present invention, the word quality refers to the audio and visual characteristics of displayed data.

Referring now in detail to the drawings, FIGURE 1 illustrates a system overview of an embodiment of the present invention. As a context for the present invention, but not the only context, consider Sender 108 to be a multimedia data server
20 that transmits high-quality multimedia data to a client. The client can use a backchannel to interact with the server, analyzing a set of parameters that represent the quality of the transmitted data, comparing the quality to a set of user preferences, and formulating a set of suggestions that are fed back to the server to alter the data such that the quality of the displayed data is affected.

In one embodiment of the present invention, as displayed in FIGURE 1, sender
25 108 transmits data to a receiver 101 which then displays the data. At 102, receiver 101 analyzes the quality of the display. At 103, a set of user preferences is received, and at 104, the quality analysis is compared to the user preferences. At 105, suggested actions are formulated and fed back along the backchannel to sender 108. When sender
30 108 receives the suggestions, sender 108 checks its status 106 and matches its current status with a set of possible actions 107. An action is chosen and the transmitted data is altered accordingly.

FIGURE 2 is a flow chart illustrating an embodiment of a method according to the present invention. In this embodiment, at step 201, received data is displayed at the
35 receiver. For the purposes of this invention, the word "received" includes, but is not

5 limited to, "created," "generated," and "selected." Therefore, the displayed data in step 201 may be received from an outside source, but it may also be, for example, internally generated. In one embodiment of the present invention, the displayed data is audiovisual, or multimedia, data.

At step 202, user preferences are received. In one embodiment of the present
10 invention, the user preferences can specify preferences to improve the quality of the display. For example, the user preference can include data that says, in effect, "when I am busy, degrade audio, degrade video, and drop texture." In one embodiment of the present invention, the user preferences can be altered by the user during the transmission. In another embodiment of the present invention, the user preferences are
15 fixed after the transmission begins.

At step 203, a set of parameters that represent the quality of the displayed data is analyzed. In one embodiment of the present invention, the set of parameters includes system load. For example, but not the only example, assuming a seven-bit word, zero can represent no load, and one hundred twenty seven can represent the system being
20 completely busy. In another embodiment of the present invention, the set of parameters includes component load, where a component is chosen from the set comprising the central-processing unit (CPU), the graphics card, and the texture-mapping engine.

At step 204, a suggestion is formulated for the sender to alter the characteristics of the transmitted data. The suggestion is formulated by comparing the results of the
25 analysis of the displayed data to the user preferences. The user preferences set some threshold for various parameters, and if the results of the analysis falls outside of that threshold, the receiver suggests to the sender to change various parameters of the transmitted data.

In one embodiment of the present invention, the formulated suggestion includes
30 timing information identifying the point in time where the data was collected, and timing information identifying the point in time when the suggested action should be honored.

In another embodiment of the present invention, the formulated suggestion includes a suggestion to alter the rate at which frames are transmitted for display. In
35 another embodiment of the present invention, the formulated suggestion includes

5 altering the color depth. In another embodiment of the present invention, the formulated suggestion includes a suggestion to alter the window size. For the purposes of the present invention, "window size" means how much screen size area the scene covers. As an example, but not the only example, assume that the displayed scene covers the entire screen, but because of limited memory, the quality of the display is
10 degraded. The formulated suggestion can include a suggestion to reduce the size of the display, thereby decreasing the need for computing power at the receiver and increasing the quality of the display.

In another embodiment of the present invention, the formulated suggestion includes a suggestion to alter audio channel characteristics. For the purposes of the
15 present invention, the phrase "audio channel characteristics" includes bandwidth, number of audio channels, and spatial audio capabilities. As an example, but not the only example, assume that the quality of the display is degraded due to memory constraints at the receiver. The formulated suggestion can then include a suggestion that the sender decrease the number of audio channels broadcast, thereby decreasing the
20 need for computing power at the receiver and increasing the quality of the display.

In another embodiment of the present invention, the formulated suggestion includes a suggestion to alter the graphics hardware load. For the purposes of the present invention, the phrase "graphics hardware load" includes, but is not limited to, matrix multiplication, texture mapping, and texture mapping memory.

25 In another embodiment of the present invention, the formulated suggestion includes a suggestion to alter the CPU load or the RAM amount available.

FIGURE 3 is a flow chart illustrating another embodiment of the present invention. At 301, data is sent by a sender to a receiver. In one embodiment of the present invention, the data sent at 301 is audiovisual, or multimedia data. In response
30 to this sent data, the sender receives a suggestion at 302 to alter the transmitted data. In one embodiment of the present invention, the received suggestion includes timing information identifying the point in time where the data was collected, and timing information identifying the point in time when the suggested action should be honored.

In another embodiment of the present invention, the received suggestion
35 includes a suggestion to alter the rate at which frames are transmitted for display. In

5 another embodiment of the present invention, the received suggestion includes a suggestion to alter the color depth. In another embodiment of the present invention, the received suggestion includes a suggestion to alter the window size. As an example, but not the only example, assume that the displayed scene covers the entire screen, but because of limited memory, the quality of the display is degraded. The received
10 suggestion can include a suggestion to reduce the size of the display, thereby decreasing the need for computing power at the receiver and increasing the quality of the display.

In another embodiment of the present invention, the received suggestion includes a suggestion to alter audio channel characteristics. As an example, but not the only example, assume that the quality of the display is degraded due to memory
15 constraints at the receiver. The received suggestion can then include a suggestion that the sender decrease the number of audio channels broadcast, thereby decreasing the need for computing power at the receiver and increasing the quality of the display.

In another embodiment of the present invention, the received suggestion includes a suggestion to alter the graphics hardware load. In another embodiment of
20 the present invention, the received suggestion includes a suggestion to alter the CPU load or the RAM amount available.

At step 303, the status is checked, and based on the current status and the received suggestion, at step 304, an action is selected from a set of actions, and the transmitted data is altered accordingly.

25 FIGURE 4 is a pictorial representation of an apparatus according to one embodiment of the present invention. The apparatus includes a port 401 coupled to processor 402, and memory 403, also coupled to processor 402 and to port 401. In one embodiment of the present invention, memory 403 stores instructions adapted to be executed by the processor to display received data, analyze the quality of the displayed
30 data, formulate a suggestion for the encoder to alter the characteristics of data to be received, and then send, through port 401, the formulated suggestion to alter the quality of the received data.

For the purposes of this application, memory includes any medium capable of storing instructions adapted to be executed by a processor. Some examples of such
35 media include, but are not limited to, floppy disks, CDROM, magnetic tape, hard

5 drives, and any other device that can store digital information. In one embodiment, the instructions are stored on the medium in a compressed and/or encrypted format. As used herein, the phrase "adapted to be executed by a processor" is meant to encompass instructions stored in a compressed and/or encrypted format, as well as instructions that have to be compiled or installed by an installer before being executed by the processor.

10 In one embodiment of the present invention, the memory stores instructions adapted to be run on the processor to receive a user preference to be used in the analysis. In another embodiment of the present invention, the formulated suggestion includes timing information identifying when the data was collected, and timing information identifying when the suggested action should be honored.

15 In another embodiment of the present invention, the formulated suggestion includes a suggestion to alter the rate at which frames are transmitted for display. In another embodiment of the present invention, the received suggestion includes a suggestion to alter the color depth. In another embodiment of the present invention, the received suggestion includes a suggestion to alter the window size. As an example, but
20 not the only example, assume that the displayed scene covers the entire screen, but because of limited memory, the quality of the display is degraded. The formulated suggestion can include a suggestion to reduce the size of the display, thereby decreasing the need for computing power at the receiver and increasing the quality of the display.

In another embodiment of the present invention, the formulated suggestion
25 includes a suggestion to alter audio channel characteristics. As an example, but not the only example, assume that the quality of the display is degraded due to memory constraints at the receiver. The formulated suggestion can then include a suggestion that the sender decrease the number of audio channels broadcast, thereby decreasing the need for computing power at the receiver and increasing the quality of the display.

30 In another embodiment of the present invention, the formulated suggestion includes a suggestion to alter the graphics hardware load. In another embodiment of the present invention, the formulated suggestion includes a suggestion to alter the CPU load or the RAM amount available.

FIGURE 5 is a pictorial representation of an embodiment of the present
35 invention. In one embodiment of the present invention, port 501 is coupled to

5 processor 502, and memory 503 is coupled to port 501 and processor 502. Memory 503 contains transmission instructions adapted to be run on the processor to transmit data to a receiver, receive a suggestion to alter the transmitted data, and then decide to alter the transmitted data.

10 In one embodiment of the present invention, the received suggestion includes timing information identifying the point in time where the data was collected, and timing information identifying the point in time when the suggested action should be honored. In another embodiment of the present invention, the received suggestion includes a suggestion to alter the rate at which frames are transmitted for display. In another embodiment of the present invention, the received suggestion includes a
15 suggestion to alter the color depth. In another embodiment of the present invention, the received suggestion includes a suggestion to alter the window size. As an example, but not the only example, assume that the displayed scene covers the entire screen, but because of limited memory, the quality of the display is degraded. The received suggestion can include a suggestion to reduce the size of the display, thereby decreasing
20 the need for computing power at the receiver and increasing the quality of the display.

In another embodiment of the present invention, the received suggestion includes a suggestion to alter audio channel characteristics. As an example, but not the only example, assume that the quality of the display is degraded due to memory constraints at the receiver. The received suggestion can then include a suggestion that
25 the sender decrease the number of audio channels broadcast, thereby decreasing the need for computing power at the receiver and increasing the quality of the display.

In another embodiment of the present invention, the received suggestion includes a suggestion to alter the graphics hardware load. In another embodiment of the present invention, the received suggestion includes a suggestion to alter the CPU
30 load or the RAM amount available.

The present invention has been described in terms of several embodiments solely for the purpose of illustration. Persons skilled in the art will recognize from this description that the invention is not limited to the embodiments described, but may be practiced with modifications and alterations limited only by the spirit and scope of the
35 appended claims.